The Actuarial Profession
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GIRO Conference and Exhibition 2011
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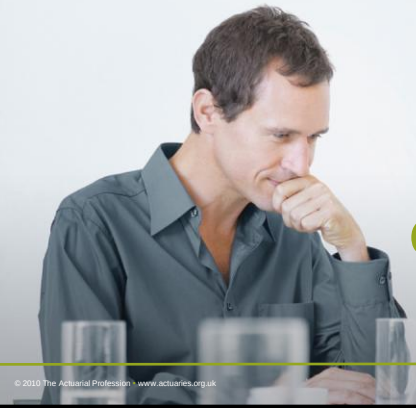


Session E12: Introduction to the CAS Loss Simulator

13 October 2011

Other Contributors to Presentation

- Hai You, Vice President Technology, Goouon Actuarial Solutions, is the programmer that created the Loss Simulation Model.
- Robert Bear, Consulting Actuary, RAB Actuarial Solutions LLC, led the working party that developed the model.
- Joseph O. Marker, President, Marker Actuarial Services LLC, led the testing of detailed model output and fitting the model.
- Kailan Shang, Associate Actuary, Manulife Financial, wrote a paper on “Loss Simulation Model Testing and Enhancement.”

Overview of Presentation

- Present a handy practical tool developed by the CAS
- Demonstrate how to use the tool
- For testing reserve methods
- For testing/modeling reserve variability methods
  - www.casact.org
  - http://www.casact.org/research/ for research

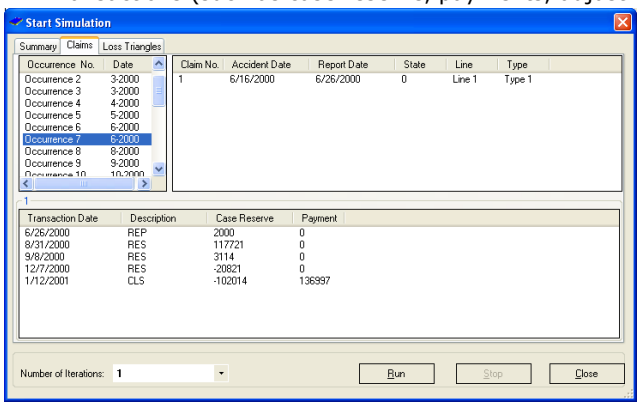
Loss Simulation Model Working Party

- Sponsored by the CAS Dynamic Risk Modeling Committee (DRMC) in 2005, the LSMWP began work in 2006.
- Purpose: creation of a simulation model that will generate claims that can be summarized into loss development triangles and complete rectangles.
- Deliverables: Open source program available to CAS members (and other interested parties), seminars, and a CAS Working Party paper documenting work.
- Time Frame: (a) Completed when model and paper were uploaded after the 2010 CLRS.
  (b) Enhanced with the 2011 CLRS Call Paper Program

All About Raw Claims

What do we try to simulate?

- Occurrences
- Claims
- Transactions (such as case reserve, payments, adjustments, etc)

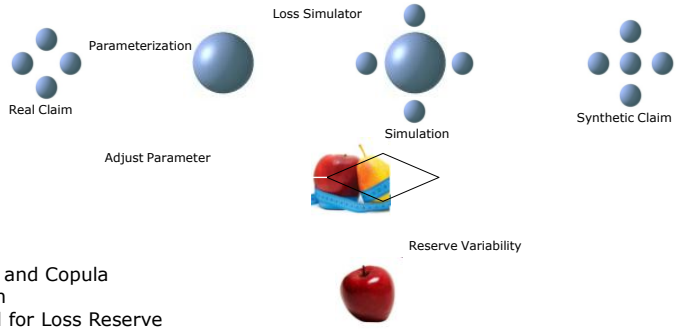


Where is the Passion (Value)?

This system will underlie the loss triangles and other statistics used to estimate loss reserves

- A platform that can generate synthetic claims
- Aid people in better understanding the underlying loss development process.
- The generated claims could be summarized into loss development triangles and complete rectangles, which could then be used to test loss reserving methods and models.
- The generated claims will have the same statistical characteristic as the company real claim data, in regarding to lags, payments, frequency, case reserves, adjustment, etc, etc.

Vision and Enhancement

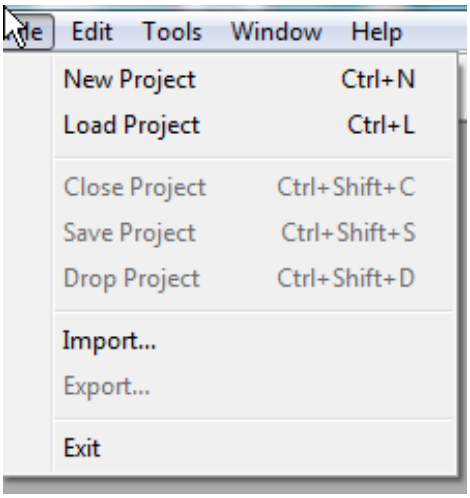


- Copula, Copula, and Copula
- Parameterization
- Predictive Model for Loss Reserve
- Challenges
  1. Real claim process is very complicated
  2. Modeling variance
  3. Parameter variance
  4. Process variance
  5. Unquantifiable variance

Launch Simulator

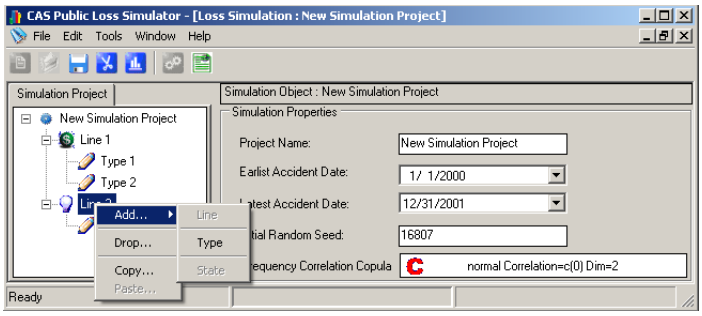
A New Project

- Create new project



Example

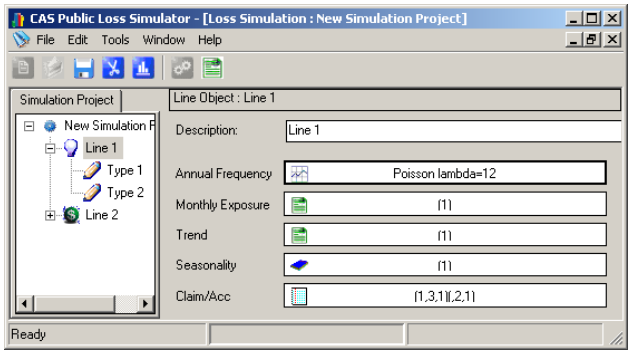
Simulation Project Parameters Setup.



- Windows Standard UI
- Tree Structure
- Accident Year Range
- Random Seed
- Line Level Frequency Correlations from Copula

Example

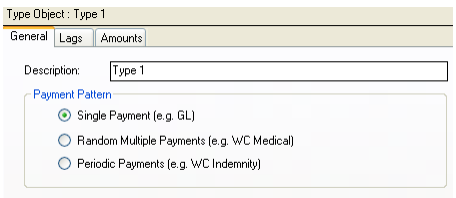
Line Level Parameters Setup.



- Annual Frequency
- Exposure, Trend, and Seasonality
- Multinomial Claim Distribution

Example

Coverage Level Parameters Setup.



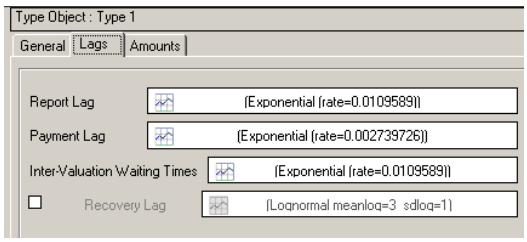
• The single-payment model approximates the development pattern of coverages such as General Liability, where each occurrence is followed by one reporting, one or more valuations, zero or one payment

• The multiple-random-payments model approximates the development pattern of coverages such as Medical Payments, where each occurrence is followed by a random number of reimbursable incurred expenses. Each expense is followed by one reporting and one payment.

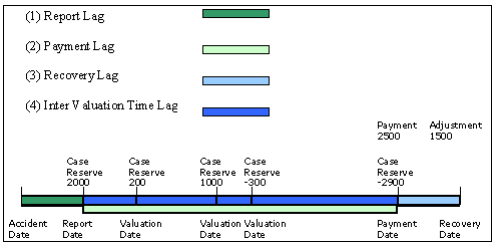
•The periodic payments model approximates the development patterns of coverages such as Group Long-Term Disability or the wage-replacement provisions of Workers' Compensation, where each occurrence is followed by a random number of regular periodic payments of equal amounts or of equal amounts subject to periodic inflation adjustments.

Example

Coverage Level Parameters Setup.

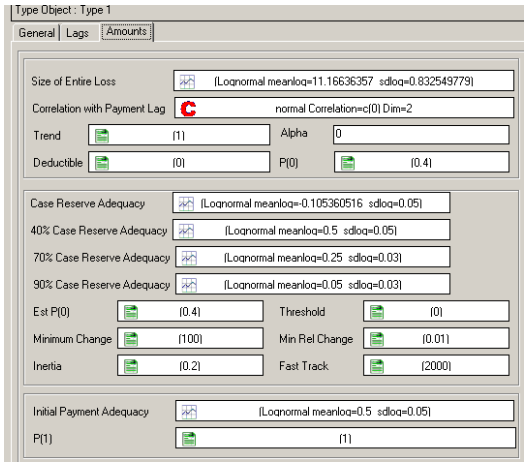


Lags



Example

Coverage Level Parameters Setup.



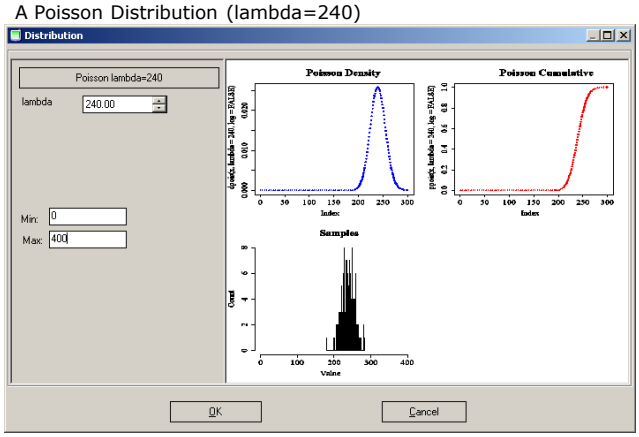
Severity Properties

Case Reserve Interpolations

Recovery Properties

Example

A Poisson Distribution (lambda=240)



LSMWP Paper

- Introduction provides overview of project.
- Survey of existing literature
- Statistical tests of simulated model output: general discussion
- Basic features in the prototype model.
- Documentation of the open source model.
- Testing detailed output and fitting the model.
- Potential applications and model enhancements.
- Appendices: User instructions including parameterization of all distributions included in the model, a bibliography, and technical details on statistical tests performed.

Accessing the Loss Simulation Model

- The help files in the new open source Loss Simulation Model document all model features.
- The Loss Simulation Model, together with all model documentation, related papers and seminars, will be located on LSMWP web page:

  www.casact.org/research/lsmwp
- Program instructions are provided in Appendix A, and are also included within the model and on the LSMWP web page.

Reserve Variability

- If you run at least 100 iterations, the model will generate reserve percentile tables and customary statistics from the simulation results (e.g., mean, standard deviation, minimum and maximum).
- These tables are distributions of payments made subsequent to the assumed valuation date, both by accident year and by calendar year and for all years combined.
- This key model feature enables users to test their models for estimating reserve variability.
- Important application: estimating capital needed to support reserves.

Reserve Variability Model Testing

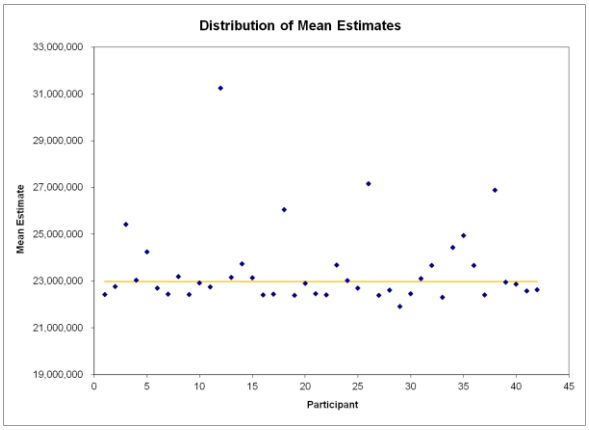
- Use older data to see how well model predicts actual outcome:
  - Observed outcome is only one possibility
  - Accounting adjustments can cloud results
  - Using multiple companies helps, but each has different exposures
- Simulate triangles (rectangles) based on model assumptions:
  - All datasets based on consistent exposures
  - Good test of model
  - But data is based on model, not necessarily reality
  - Should only test model(s) on which simulated data is based

- Simulate claim transaction details:
  - All datasets based on consistent exposures
  - Data should reflect reality instead of model being tested
  - Can test ALL models with same data
  - Can systematically change exposure profile to test how they impact model results (e.g., number of exposures, deductibles, limits, reinsurance, calendar period inflation, etc.)

Reserve Variability Model Training

- CAS Sponsors a 3 day hands on Seminar on Reserve Variability Models
- As part of the seminar, we created a database of 1,000 rectangles using the Loss Simulation Model
- We selected one set of triangles (1 set out of 1,000) and asked participants to estimate mean, standard deviation, 75th, 90th and 99th percentiles.
- Participants can use any model(s) of their choice.

Reserve Variability Model Training



Actual Mean = 22,979,672

Average Answer = 23,259,224

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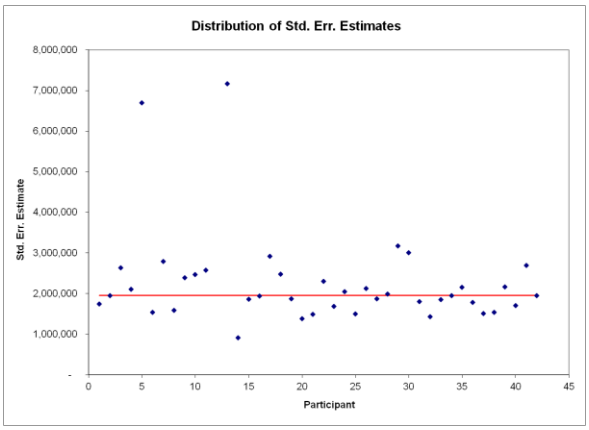
Reserve Variability Model Training



Actual Std Dev = 1,949,039

Average Answer = 2,259,237

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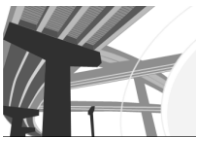
Future Work

- The documentation within the model and on the CAS web site will be kept up to date as this open source software is enhanced. For example, the model was updated to work on a Windows 7 operating system.
- The DRMC will work with Kailan Shang to implement the model enhancement he developed as well as his recommendations for improving the model arising from testing he performed and documented in his paper.
- Contact DRMC Chairperson if the instructions need clarification, if program bugs are discovered or if you would like to help improve the model.



Summary

- The LSMWP developed and fully documented a model that we hope will become a valuable tool in researching loss reserving methods and models.
- We encourage actuaries to develop and document model enhancements through call paper programs.
- We hope that actuaries will use this model to:
  - Better understand the underlying loss development process.
  - Determine which methods and models work best in different reserving situations.
  - Reflect this knowledge in evolving loss reserving practices.

Testing the Model and its Benefits

- Testers set up LSM parameters for situations where the output distribution is known.
- Then tested distribution of simulated output vs. the theoretical distribution.
- If not a good fit, looked for:
  bugs in the LSM
  misunderstanding of how parameters work
- Important: The "R" code used for the testing is available in the various papers relating to the LSM.

Testing the Model and its Benefits

- The same "R" code used for testing can also be used to parameterize the model on an insurer's actual detailed loss data.
- To do this:
  Reformat the real data to the format of the LSM's detailed output files.
  Apply the "R" code used for testing to produce parameters for specific
  distributions and to measure the goodness of fit.
- Note: The detailed output files from the LSM include, for each claim, all the reserve changes and their dates.

Testing the Model and its Benefits

- What if modeler has only life-to-date claims evaluated as of one valuation date?
- Case 1: Claims are essentially at ultimate valuation.

  The LSM produces ultimate claim values before it simulates the reserve and payment transactions that lead to the ultimate values.

  The "R" code is full of tests for ultimate claim count and ultimate severity.
- Use the "R" code to fit the ultimate frequency and severity.

Testing the Model and its Benefits

- Case 2: Claim data is not fully developed
- The LSM uses parameters that model the development of individual claims.
- The LSM produces aggregate loss development triangles.
- The modeler may need to experiment with development parameters until the aggregate triangles look similar to the insurer's historical development.
- Kailan Shang will discuss testing of the development parameters under the topic "Case Reserve Adequacy".

Call Paper Program

- The Casualty Actuarial Society had a call for papers on the topic of “Testing Loss Reserving Methods, Models and Data Using the Loss Simulation Model.”
- Participants worked with the Loss Simulation Model to develop enhancements to the model, perform additional testing, and apply the model to test alternative loss reserving methods and models.
- First place went to Kailan Shang, “Loss Simulation Model Testing and Enhancement”

Shang – Loss Simulation Model Testing and Enhancement

- Tested frequency distribution
- Tested Severity trend and alpha
- Tested correlations
- Tested case reserve adequacy
- Testing based on Marine claims
- Contains Appendix with extensive R code

Let's Run Some Examples

Questions?